EXHIBIT 7

AT&T Wireless Services, Inc.

Bellevue MNLS Trial

Phase 2: E911 Location Technology Trial

Document Number
Revision 0.1
Revision Date 06/11/01

Technology Development Group
Base Station Development
AT&T Wireless Services, Inc.
PO Box 97061
Redmond, WA 98073

1. Purpose

The FCC specifies an October 2001 deadline for providing location-based capability for wireless services. That time limit—for Phase II of the FCC's enhanced 911 (E911) order of 1996—requires that each wireless telecommunications company doing business in the United States must offer either handset- or network-based location detection capability. The FCC requires that network-based systems must be accurate within 100 meters for 67 percent of calls and within 300 meters for 95 percent of calls.

This document provides a technical summary of the drive-test efforts and analysis performed for the E911 Mobile Network Location System (MNLS) trial in Bellevue, Washington performed in 2001.

2. Overview

2.1. Introduction

Positioning technologies for cellular systems may be differentiated based on the types of measurements made. The most common measurements involve analysis of the radio signal transmitted or received by the mobile terminal to be positioned. These analyses are:

- Time of arrival (TOA)
- Time difference of arrival (TDOA)
- Angle of arrival (AOA)
- Received signal strength (RSS)

An RSS-based positioning technique referred to as Mobile Network Location System (MNLS) has been proposed for positioning in TDMA networks. In this technique, RSS measurements are made by the mobile terminal on downlink channels from the serving and neighboring base stations. These RSS measurements are then used by the Position Determining Equipment (PDE) in the cellular network to compute the position of the mobile terminal, given knowledge of the transmitted powers from the base stations, the locations of the base stations, and the sector layout in the coverage area.

In TDMA systems, the mobile terminal can be ordered to make RSS measurements when it is camping on the control channel and when it is on a traffic channel. In the former case, RSS measurements are used for mobile-assisted channel allocation (MACA); in the latter case, RSS measurements are used for mobile-assisted handoff (MAHO). The advantage of MNLS is that TDMA digital cellular standards already call for the mobile terminal to make RSS measurements for network management reasons; therefore the MNLS method has minimal impact on TDMA digital cellular standards.

This document describes the performance of the MNLS method in a TDMA network. Measurements were made in Bellevue, WA.

First, a set of RSS measurements on downlink channels was used to construct a database at different positions within the coverage area. A second set of RSS measurements was then used to test positioning performance of MNLS in the test area.

The Section 2.2 describes the measurement and prediction data in greater detail. Section 3 discusses the MNLS performance.

2.2. Field Measurements

Field measurements were conducted by AT&T Wireless in the Bellevue area using an Ericsson T-18D TEMS mobile phone, a computer with TEMS software for logging measurement data from the phone, and a GPS receiver.

Figure 1 is a map of the roads used for the Bellevue MNLS Trial. For collection and display purposes, the measurements were broken into separate drive routes or loops.

Measurements were made in idle mode of the RSS downlink measurements of the serving and neighbor cells. The TEMS software logged both the RSS measurements and GPS position data.

The RSS/GPS measurements were then used to create a database for the coverage area. The grid size of the database was 50 meters.

Similar measurements were then made in active mode of the RSS downlink measurements of the serving and neighbor cells. The active mode measurements were made by calling a test number that played a local radio station.

MNLS position was calculated using the database created from the idle mode measurements. Every 5 measurements were used together for MNLS calculation purposes. The TEMS mobile phone reports MAHO scans every 1.28 seconds. Therefore, a MNLS position was provided every 6.4 seconds.

Position error was determined using the first of the five GPS positions. Care was taken to verify all 5 of the GPS/RSS measurements were within 50m of each other.

Figure 1. Map of the roads used for the Bellevue MNLS Trial.

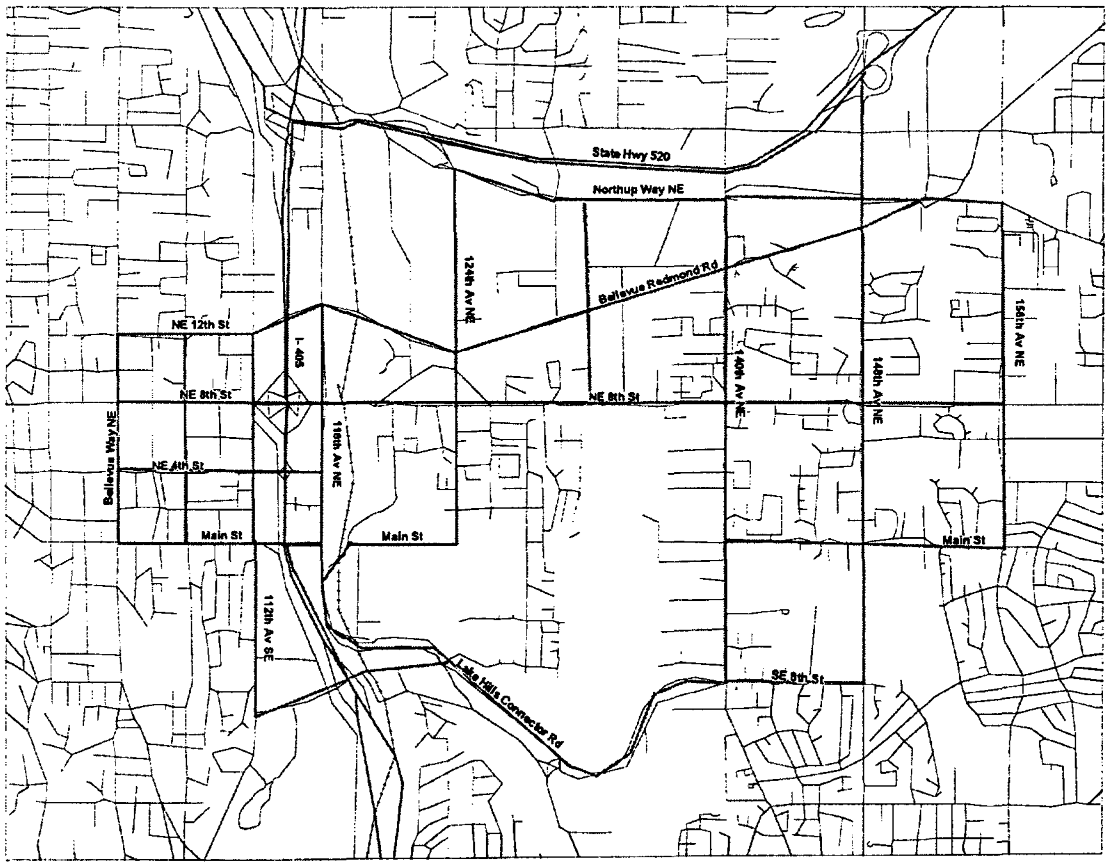
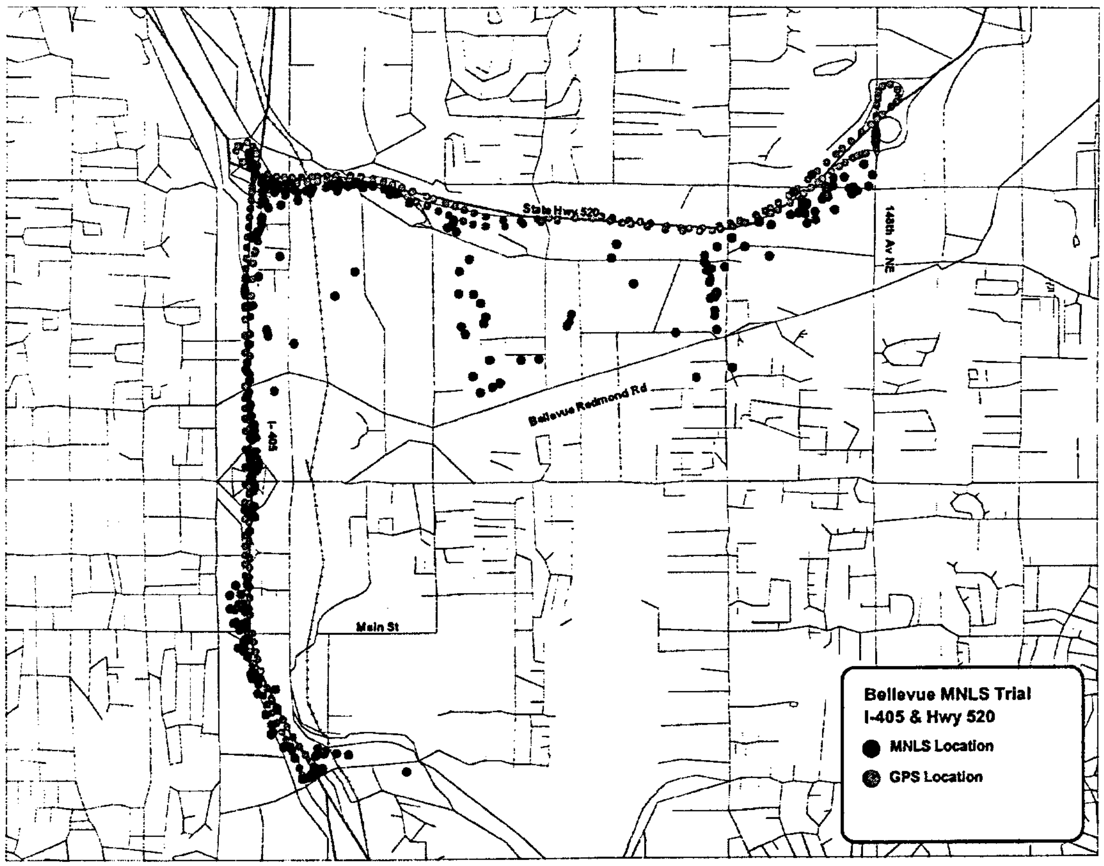


Figure 2. Freeway Loop. Measurements were made on Hwy 520 (east and west), and I-405 (north and south).



3. MNLS Performance

Table 1 summarizes MNLS position errors measured in this trial (expressed as percentages).

Table 1. Bellevue MNLS Trial Position Errors.

	Probability		
	67%	95%	Number of Measurements
Total Aggregate Position Error	301 m	708 m	1935
Freeway Loop (Figure 2)	232 m	785 m	263
Loop 1 (Suburban)	338 m	998 m	429
Loop 2 (Sub/Rural)	324 m	704 m	528
Loop 3 (Urban)	254 m	582 m	162
Loop 4 (Urban)	289 m	585 m	235
Loop 5 (Dense Urban)	345 m	527 m	196
Loop 6 (Urban)	195 m	339 m	122

3.1. Performance Improvements

3.1.1. Grid Size

In general, smaller grid sizes are expected to provide better performance and the choice of grid size should be based on the expected performance with a certain database. In order to ensure the best possible performance with a given database, a grid size in the range of 50 meters is recommended.

3.1.2. Database Quality

In order to improve the performance of MNLS in the future, the main factor to be targeted is the quality of the database. Database quality may be improved in the following ways:

- More accurate RF propagation models will improve the quality of the prediction data.
- Measurement data over the whole coverage area is expected to have better quality than prediction data and, if available, could be used to build the database.
- Periodic testing of a database built from prediction data could be used to determine which regions and/or channels have the poorest quality, and the corresponding data can be replaced or augmented with measurement data. That is, a hybrid database that includes both prediction data and measured data can be used.
- A smaller grid size can be used for regions in the densely-populated coverage areas.
- Extra information, such as map data for the coverage area, may be used to reduce the number of possible location estimates and thus improve performance.

Note: The databases used to generate results in this were generated for the purpose of a field trial only. The database generated from measurements could have been enhanced with measurements gathered with more density while the database generated with prediction data could have had data for more neighboring control channels. Having a more complete database in both respects should result in better performance in a practical implementation.

EXHIBIT 8

AT&T Wireless Services, Inc.

TruePosition Test Report

TruePosition (Network-Based)

Phase II E-911 Location Technology Trial

Document Number	**10315**
Revision	**1.0**
Revision Date	**03/23/2001**

Technology Development Group
AT&T Wireless Services, Inc.
PO Box 97061
Redmond, WA 98073

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1. Introduction

In an effort to prepare for compliance with Federal Communications Commission Docket #94-102 regarding Phase II Enhanced 9-1-1, AT&T Wireless is endeavoring to review and consider all potential technical options. In some cases, lab testing and/or field trials are being conducted to allow AWS technical teams to learn more about the various technologies and determine whether they can both meet the Commission mandate and AWS' own internal standards for customer service and network quality.

TruePosition, a network-based Phase II technology vendor, was selected for a field trial in the Redmond, WA area. The vendor installed a Mobile Station (MS) location system in seven cell sites intended to provide latitude-longitude locating information of signals of interest accessing a control channel on the AWS wireless system.

In order to demonstrate compliance with the FCC mandate, network-based technology solutions are required to provide an accuracy of 100 meters 67% of the time and 300 meters 95% of the time.

The testing focused on accessing the accuracy requirements. This document provides the test results from the performance and operation of this trial.

1.1. Trial Objectives

The objective of this trial was to get a basic understanding of the capabilities of the TruePosition technology. The major emphasis for the tests are:

- Learn the issues associated with the installation process
- Understand the initial configuration and optimization issues
- Understand the limitations of the coverage
- Understand the accuracy of the covered areas
- Estimate the manpower requirements for maintenance and operation

No network element testing or system load testing was accomplished (or was intended) other than the functionality of those network elements necessary for the calculation of mobile position.

1.1.1. Trial Area Demonstration

TruePosition and AWS teams met to determine an appropriate coverage area in which to conduct the trial with the following goals: The TruePosition and AWS teams met to determine an appropriate coverage area in which to conduct the trial, with the following goals:

- A number of cell sites large enough to yield meaningful test results and meet trial objectives, but small enough to be manageable for a relatively small technical team
- A wireless environment representative of most areas covered by the AWS network nationwide (but not an abnormally challenging RF environment)
- Geographically located close to AWS' technical team headquarters and lab facilities

The two teams jointly agreed to conduct the trial utilizing seven cell sites in the Redmond, WA area. The sites were mainly sectorized (one omni-directional site) 850 MHz, IS-136 and analog, relatively low power base stations in a mature (fully build-out) wireless environment, including two rooftop installations and five monopoles (approximate height 120 ft.).

2. Test Philosophy

The main object of the testing is to determine the accuracy of the TruePosition system. Currently, the FCC has not mandated how or if the accuracy will be tested. For the purposes of this trial, AWS addresses accuracy testing via methodologies:

- Define a set of known test points and perform a number of tests from those points
- Drive the area in question using a known reference such as a DGPS receiver.

There are advantages and disadvantages of both philosophies. Testing at a known location is simpler to test and it is easier to calculate results. A disadvantage of testing at a known location is that the testing does not cover all areas well and it does not constitute a variety of real life environments.

Drive testing covers the test area and constitutes more of a real life environment but it is more complicated to calculate results. Both test philosophies were performed.

3. Test Set-Up

The test set-up was composed of the following equipment:

- TEMS software
- TEMS Ericsson KH688 mobile
- Garmin GPS III Plus
- GBR 21 Differential GPS receiver
- Motorola Microtac mobile (analog only)
- Nokia 6160 mobile

The equipment was mounted inside the vehicle except for the GPS and Differential GPS antenna. The mobiles were located above the dash inside the vehicle. The TEMS software was set to make a call every ten seconds. The other mobiles were manually dialed. Three variations of tests were performed:

- Stationary tests using the TEMS, Nokia and Motorola mobiles (two digital, one analog)
- Drive tests using the TEMS mobile
- Indoor tests using Nokia 6160

TruePositions published coverage area for the test area is shown in Figure 1. The drive tests were designed to cover this area. The predicted coverage is based upon simulation results, where:

- Green area has average expected location accuracy of less than or equal to 100 m.

- Blue has expected location accuracy of more than or equal to 100 m.

- White has average expected location accuracy more than 1000 m.

Figure 1. Predicted Coverage Based on TruePosition Simulation Results

Note: TruePosition calculated high confidence areas of locations based upon RF simulation tools. These tools used terrain data and cell site locations to determine the high confidence areas. All tests were performed inside TruePosition's confidence areas with separate drives performed to distinguish differences.

The following test cases were performed:

- Known test points (South area)

- Known test points plus drive tests (South area)

- Drive test (South area)
- Drive test (North area)
- In-building test

4. Test Issues

The following are issues that arose during the trial.

4.1. Site Connectivity

Initially, there were a number of connectivity issues that slowed the process of installing the TruePosition equipment both into the sites and into lab. Below is a summary of the hurdles that were addressed:

- DS0 at the cell site – There is no easy way to get a DS0 from the cell site T1s that were already installed (other than a Frame Relay connection).
- Local interconnect set-up – GTE was slow in getting T1 connectivity to each site.
- TruePosition interconnect design – The TruePosition design did not accommodate different interconnection options, i.e., no CSU/DSU functionality, Frame Relay, Ethernet or IP support.

4.2. RF Connectivity

The cell sites were surveyed to use the available multicoupler ports on the Ericsson base station equipment. These ports are considered the most accessible ports on the Ericsson base stations, i.e., most sites have an available multicoupler port. During the trial it was determined that these ports did not have enough gain to meet the TruePosition receiver requirements (gain = +5.5 dB). TruePosition reconnected to the high gain ports where available (these ports are typically reserved for additional cabinets). Also, TruePosition changed their receiver hardware to compensate for lower gain.

4.3. RF Design

TruePosition used a number of GDOP plots to indicate the coverage of their system. The initial plot did not take terrain into account. The subsequent plots included terrain data, but TruePosition has raised questions regarding the accuracy of that data.

4.4. Beta Equipment

Since the TruePosition equipment used for the trial was still inBeta, there were continual updates being made. In fact, during the two-week trial, TruePosition implemented at least one new software update and one new hardware update that did not get into the test. During the few months TruePosition had installed hardware, there were four major software revisions and two major hardware revisions.

4.5. RF Environment

TruePosition indicated its belief that the RF environment in the test area was "very rough," indicated by measured interference at some sites which showed significant interference from transmitters such as Nextel, and has noted that the terrain in the Redmond area is not conducive to good accuracy measurements. However, there is no evidence that the Redmond area wireless system is more problematic than any other mature wireless network, and the FCC do not allow for reduced accuracy performance based on terrain.

4.6. Control Channel

Although a majority of the calls were located, it was noted that a small percentage (~ 5%) were unable to get a location. Also, a number of the calls were located but the confidence level of the calls was low.

4.7. Equipment Maintenance

The AWS technical team's general impression about maintenance was the equipment was very unstable and challenging to maintain. Component outages appeared extremely common and replacement of several of the TLPs and a number of SCSs was necessary.

4.8. Equipment Installs

The cell site installations went fairly smooth. Installations proceeded at about two a day (utilizing one AWS technician and two TruePosition personnel). The install involved mounting hardware into the racks, mounting an outdoor GPS antenna, and connecting to the RF receive ports, power and T1. One RF connection was installed improperly and later fixed.

4.9. Conclusions

Test results are summarized in Table 1below.

Table 1. Summary of Test Results

Test Case	67% (FCC requirement 100 m)	95% (FCC requirement 300 m)
Known test points	266	810
Drive plus known test points	286	833
Drive test (south area)	318	965
Drive test (North area)	371	1226
In-building test	299	448

The following conclusions have been drawn from the trial results:

- The trial area represented a typical real-world operating environment representative of AWS' national network.
- The technology tested in this trial failed to meet FCC accuracy requirements for a network-based location system.
- The technology, when tested was in Beta stage, required a high level of maintenance, tuning and optimization. Reliability in a larger scale implementation and system stability overall appear to be major issues.
- The TruePosition and AWS trial teams, despite cooperative efforts over a period of weeks, were unable to determine short-term fixes to substantially improve accuracy performance.

EXHIBIT 9

AT&T Wireless Services, Inc.

Grayson E-911 Trial Technical Summary

E-911 Location Technology Trial

Document Number	10427
Revision	1.0
Revision Date	03/23/2001

Technology Development Group
AT&T Wireless Services, Inc.
PO Box 97061
Redmond, WA 98073

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1. Overview

1.1. Introduction

In an effort to prepare for compliance with Federal Communications Commission Docket #94-102 regarding Phase II Enhanced 911, AT&T Wireless is endeavoring to review and consider all potential technical options. In some cases, lab testing and/or field trials are being conducted to allow AWS technical teams to learn more about the various available technologies and determine whether they meet the FCC's mandate and AWS' internal standards for customer service and network quality.

Grayson Wireless, a network-based Phase II technology vendor, was selected for a field trial in the Redmond, WA area. Grayson's network-based solution is called Geometrix. The vendor (Grayson) installed pre-production Wireless Location Sensor (WLS) devices in seven Redmond area cell sites.

Grayson's WLS provides Time Distance of Arrival (TDOA) measurements on TDMA and AMPS voice channels. The TDOA measurements are processed by Grayson's Geolocation Control System (GCS) to determine the latitude and longitude of the desired mobile. The GCS for this trial was located in the lab area at AWS' Redmond Town Center Building 2.

In order to comply with the FCC mandate, network-based technology solutions are required to provide a location accuracy of 100 meters 67% of the time and 300 meters 95% of the time.

AWS testing focused on accessing the accuracy and functionality of the Position Determining Equipment (PDE).

1.2. Trial Objectives

The objective of this trial was to get a basic understanding of the capabilities of Grayson's Geometrix technology. The major emphasis of the tests were to understand:

• The WLS and GCS installation process

• Initial configuration and optimization

• Coverage and accuracy limitations

• How to estimate the manpower requirements for installation

No network element or system load testing was intendedfor this trial, other than the functionality of those network elements necessary for the calculation of mobile position.

2. Summary Analysis

2.1. Test Environment

2.1.1. Trial Area

The first PDE trial was with True-Position. True-Position and AWS teams met to determine an appropriate coverage area in which to conduct the trial with the following goals:

• A number of cell sites large enough to yield meaningful test results and meet trial objectives, but small enough to be manageable for a relatively small technical team.

• A wireless environment representative of most areas covered by the AWS network nationwide (but not an abnormally challenging RF environment).

• A test bed located near the AWS' technical team headquarters and lab facilities.

The two teams jointly agreed to conduct the trial utilizing seven cell sites in the Redmond, WA area. The sites were mainly sectorized (one.omni-directional site) 850 MHz, IS-136 and analog, relatively low power base stations in a mature (fully built-out) wireless environment, including two rooftop installations and five monopoles (approximate height 120 ft.).

For consistency in comparing test results, the Grayson trial used the same sites as the True-Position trial.

2.1.2. Test Philosophy

The main object of the testing was to determine the accuracy of Grayson's Geometrix System. Currently (in), the FCC has only suggests how accuracy measurements will be tested and reported.

For the purposes of this trial, AWS addresses accuracy testing via the following methodologies:

• Define a set of known test points and perform a number of tests from those points.

• Drive the area in question using a known reference such as a D-GPS receiver.

Both test philosophies were performed for the Grayson Trial in Redmond.

3. Testing Issues

• This trial was conducted with pre-production two channel TDOA WLS units (TDOA-2). The pre-production hardware only supports 850 MHz at this time.

• The seven Redmond area sites used for the Grayson trial were legacy sites from the previous True-Position Trial. No coverage or drive test information for the Redmond area was supplied to Grayson for analysis with their modeling tool. As a result, some areas driven were outside the Geometrix service area. This will not be a problem in Denver because of the market design procedure detailed in Section 4.

• There is no portable test platform available at this time to conduct in-building and walking location testing.

• Grayson WLS and GCS equipment downtime because of the following:

– V.35 software driver problems at all sites that required a T-1to Ethernet router (Lucent Pipeline) to be installed at each site. This problem will be corrected prior to Denver trial.

– Interconnect failure (T-1) at Bridal Trials. GTE repaired T-1 the next day.

– GPS antenna failure at DT Redmond. Grayson replaced the antenna the same day.

– Incorrect framing out of Lab DACS. Delayed start of testing by one to two weeks.

– Several resets of the GCS (Sparq Work Station) were required because of a failure to reboot after new software was uploaded. This problem has not returned, Grayson indicated that the lock-ups were because of mistakes on its end.

4. Conclusions

Overall test results are summarized in Table 1.

Table 1 Summary of Results

Test Case	67% (FCC requirement of within 100 meters)	95% (FCC requirement of within 300 meters)
TDMA Stationary	164	258
AMPS Stationary	211	330
West Redmond TDMA Drive	245	474
North Redmond TDMA Drive	424	771
West Redmond TDMA Drive	570	1012
North Redmond TDMA Drive	855	1624

The following conclusions have been drawn from the trial results:

• The trial area represented a typical real-world operating environment representative of AWS' national network.

• The technology tested in this trial failed to meet current FCC accuracy requirements for a network-based location system.

• The technology tested in this trial was in Beta stage; accuracy improvements expected with future enhancements merit further testing.

• The current equipment deployed in the Redmond Trial did not meet the current FCC accuracy requirements. However, accuracy improvements are expected with future enhancements like TDOA-4 and AOA WLS hardware. AWS should proceed with the Denver Trial using pre-production TDOA-2, 4, and AOA.

EXHIBIT 10

AT&T Wireless Services, Inc.

Grayson E-911 Trial (Urban Denver, CO): Technical Summary

Phase 2: E-911 Location Technology Trial

Document Number	**10605**
Revision	**0.3**
Revision Date	**02/01/01**

Base Station Development
AT&T Wireless Services, Inc.
PO Box 97061
Redmond, WA 98073

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1. Purpose

This document provides a TDG technical summary of the testing efforts and analysis that has been done regarding the E911 Grayson Position Determining Equipment (PDE) trial in Denver, Colorado.

2. Overview

2.1. Introduction

In an effort to prepare for compliance with Federal Communications Commission (FCC) docket #94-102 regarding Phase II Enhanced 911, AT&T Wireless is endeavoring to review and consider all potential technical options. In some cases, lab testing and/or field trials are being conducted to allow AWS technical teams to learn more about the various technologies in order to determine whether they meet the FCC mandate and AWS internal standards for customer service and network quality.

In 2000, Grayson Wireless, a network-based location technology vendor, was selected as a finalist in an RFP process. Grayson's Geometrix product comprises two pieces of hardware: a Wireless Location Sensor (WLS) that provides Time Distance of Arrival (TDOA) measurements on TDMA and AMPS voice channels, and a Geolocation Control System (GCS). The TDOA measurements made by the WLS are processed by Grayson's GCS to determine the latitude and longitude of the desired mobile.

In order to demonstrate compliance with the FCC mandate, network-based technology solutions are required to provide an accuracy of 100 meters for 67% of the calls and 300 meters for 95% of the calls.

The testing focused on assessing the accuracy and functionality of the Position Determining Equipment (PDE).

AWS provided Grayson with a rough estimate of the coverage area that encompassed the rural and urban environments we were testing. We were attempting to meet the FCC mandated accuracy in the areas for which Grayson had installed 18 pre-production WLS devices in selected Denver-area cell sites.

Grayson's WLS provides Time Distance of Arrival (TDOA) and Angle of Arrival (AOA) measurements on TDMA and AMPS voice channels. With TDOA, the location of the mobile station is derived by measuring the time or time difference of arrival of the signal from mobile station to multiple base stations. TDOA requires a minimum of three sites to provide an accurate location. With AOA, the location of a mobile station is derived by measuring the angle of arrival of the signal from the mobile station at multiple base stations. AOA requires a minimum of two sites to provide an accurate location. The TDOA and AOA signal from measurements are then processed together by Grayson's GCS to determine the latitude and longitude of the desired mobile. The GCS for this trial was located in the third floor of the AT&T Champa switch in downtown Denver.

2.2. Trial Objectives

There were several objectives for the second phase of the Grayson trial. The initial trial took place in Redmond, Washington. The goal of this trial was to test Grayson's Geometrix TDOA network overlay product in a suburban environment (there is a separate document describing the findings in Redmond). The trial was then expanded to Denver, Colorado in an effort to test an urban and rural environment.

In addition to testing in an urban and rural environment, AWS wanted to gain an understanding of the following issues:

- The performance of Geometrix in an urban and rural environment.
- WLS and GCS installation processes, including manpower requirements for installation.
- Initial configuration and optimization.
- Coverage and accuracy limitation and improvement.
- The abilities of Grayson's planning tool.

No network element or system load testing was intended for this trial, other than the functionality of those network elements necessary for the calculation of mobile position.

3. Summary Analysis

3.1. Test Environment

3.1.1. Trial Area

Two trials of location technology have taken place in Redmond. TruePosition was the first trial and Grayson was the second. Both trials used the same sites for consistency in comparing test results.

The sites in Redmond were mainly sectorized (one omni-directional site) 850 MHz, IS-136 and analog, relatively low-power base stations in a mature (fully built-out) wireless environment, including two rooftop installations and five monopoles (approximate height 120 ft.).

Results from Redmond trials are shown in Table 1 on the following page.

Note: Because there was no portable test platform available to conduct in-building and walking location tests for Grayson in Redmond, that data is missing from Table 1.

Table 1 Redmond PDE Trials Results

Test Case	67% (FCC requirement 100 m)	67% (FCC requirement 100 m)	95% (FCC requirement 300 m)	95% (FCC requirement 300 m)
	TruePosition	Grayson	TruePosition	Grayson
Stationary	266 meters	164 meters	810 meters	258 meters
North Area	371 meters	424 meters	1226 meters	771 meters
South Area	318 meters	245 meters	965 meters	474 meters
In-building	299 meters		448 meters	

Neither the TruePosition not the Grayson system met the FCC-mandated accuracy.

Grayson Wireless offered a combined AOA and TDOA solution for the rural and urban environments. The solution provided by Grayson and the results demonstrated in Redmond indicated further study of this solution was needed. Therefore, Trial B was expanded to Denver, Colorado.

Grayson participated in the site selection. Grayson was given a list of cell site locations in the Denver area, and was given the freedom to determine the sites in the Denver downtown area that they needed in order to meet the FCC Requirements for accuracy. Grayson chose 18 TDOA sites for urban testing and four AOA sites to test rural coverage (rural coverage testing will be completed in the next phase and will be covered in a separate report). No testing was done outside the coverage area. Figure 1 shows a map of the Denver area and the location of all the WLS and GCS sites.

Figure 1 Denver Site Map

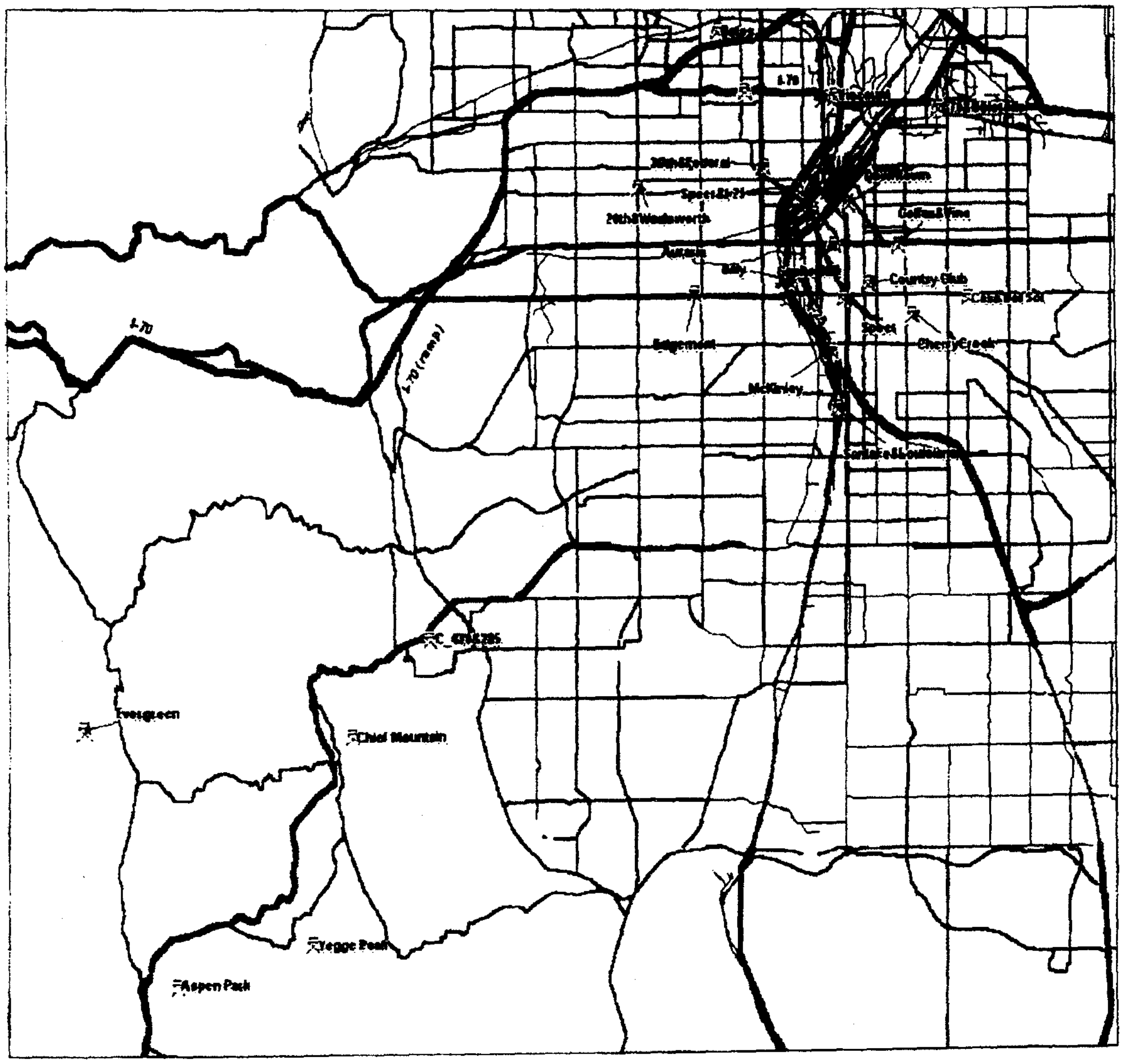


Figure 2 Predicted 67% Accuracy Downtown

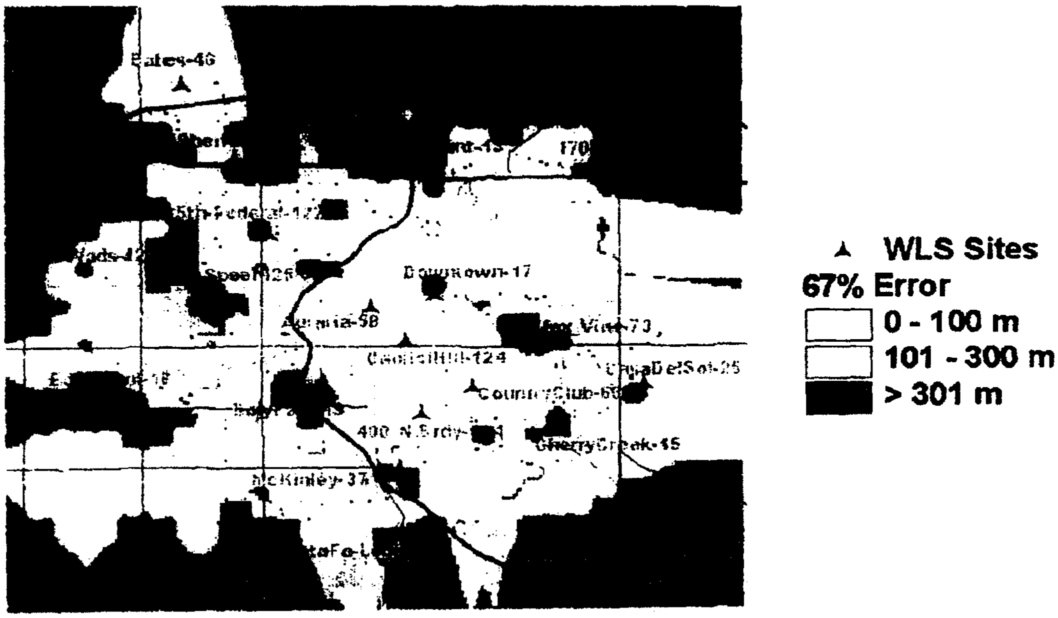
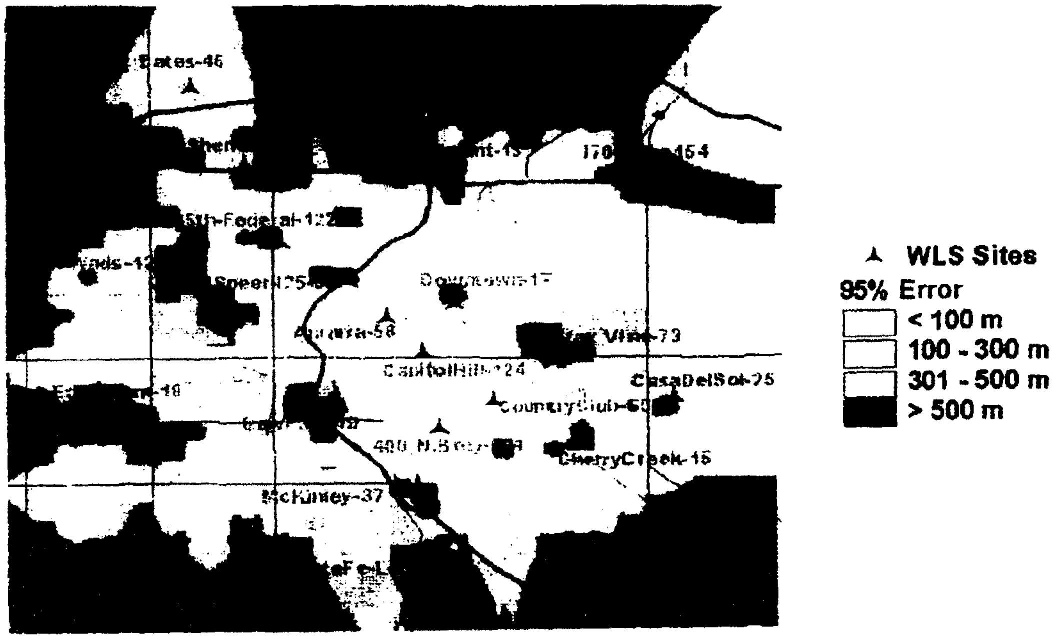


Figure 3 Predicted 95% Accuracy Downtown



The sites in Denver were mostly sectored (two, three and four), with a few omni-directional sites. Site height ranged from 30 feet to 200 feet.

3.1.2. Test Philosophy

The main object of the testing was to determine the accuracy of Grayson's Geometrix system. Currently, the FCC has only suggested how accuracy measurements are to be tested and reported in FCC OET Bulletin No.71. This document is only a suggestion and is not binding at this time.

For the purposes of this trial, AWS addresses accuracy testing via the following methodologies:

- Define a set of known test points and perform a number of tests from those points.

- Drive the area in question using a known reference, such as a DGPS receiver.

Both methodologies were used for the Grayson trial in Denver.

Because cellular phones are being used in a wide range of environments, it is necessary to how the hones behave in different types of propagation environments in order to analyze and evaluate a wireless location technology. The test cases were created to represent the conditions of actual wireless communications regions and are classified as follows:

Table 2 Denver Grayson Field Trial Test Cases

Test Cases	Environment
Dense Urban	Generally flat, high-rise stone and brick office buildings, hotels from 3 to 40 stories, and a few multi-floor residential apartments. Mostly wide, one-way, two to three-line streets..
Urban	Flat, high, residential area with one, two, or three-floor apartments of wood-frame construction, business centers outside downtown high-rise buildings, medium tall trees along the mostly two-ways streets..
Light Urban	Medium-level population, one or two-floor residential neighborhood, shopping centers, one or two-floor business and industrial complexes.

For the purposes of this trial, AWS simulates the statistical model of E911 calls via the following methodologies:

- **Stationary Testing**: Using a statistically equivalent number of E911 calls (based on past E911 call data) we defined a set of known stationary test points and performed a number of tests with calls lasting a particular duration.
- **Mobile Testing**: The test routes were also determined by using the call density of the cell site. The drive area was driven using a DGPS receiver. In addition, some test routes are located in the general coverage region as well as the dense area.

Both methodologies were used for the Grayson trial in Denver.

4. Testing Issues

- This trial was conducted with pre-production, two-channel TDOA WLS units (TDOA-2). Some of the sites had four-channel capability, but this capability was not enabled for the testing. All testing was completed using only two channels.
- Grayson WLS and GCS equipment experienced downtime during the trial period due to:
  - Interconnect failure (T-1) at Colfax, site 73, Federal and 35th, site 122. AWS local market repaired T-1 the next day.
  - GPS antenna failure at Site 184 Speer. After the installation of the GPS antenna, there was a new construction project that blocked the ability of the GPS antenna to see the satellites. Grayson relocated the antenna the next day.
- Grayson had to relocate three TDOA sites due to zoning issues with the AOA antennas. It took approximately two weeks to get the sites moved and operational.
- The Goldhill site (prior to it being moved) had no available room in its cable chase. In order to install additional cable, another chase would have needed to be built at a substantial cost.
- Several resets of the GCS (Sparc workstation) were required due to modem failure. Grayson finally replaced their modem.
- During testing the Grayson Virginia office lost power, causing a delay in testing.
- Landlord issues: Due to a problematic landlord, Grayson had never been able to put a GPS antenna on the I-70 Sheridan site. This affected the coverage Grayson was able to provide.
- Algorithm changes: Several changes were made to the WLS and the GCS algorithms in an attempt to improve performance and reduce the impact of multipath.
- Code problems: Grayson's GCS code had an intermittent problem that caused the system to halt. Grayson was able to find and address this problem.

- IP connectivity: We lost our ability to communicate with the GCS twice due to some unknown party taking and using the IP address assigned to the GCS.
- Kentrox problems at three sites. When there are IP address changes, the Kentrox needs to be reconfigured. This required someone to go on site. Some of the problems with these units were due to incorrectly following procedures.
- Several iterations of the coverage maps were generated (the final coverage maps of the trial area are shown in Figures 1 through 3). As previously stated, most of the tests did not meet the mandated accuracy. Significantly more work needs to be put into the prediction tool. The coverage prediction tool does not take into account four-channel TDOA. Estimations of coverage for four-channel units must be calculated manually. The tool also doesn't handle AOA coverage prediction.

5. Conclusions

Overall test results are summarized in Table 4:

Table 3 Average Accuracy

Test	67%	95%	Total Number of Test Points
Stationary indoor	525 meters	905 meters	511
Stationary on-street	590 meters	1130 meters	525
Stationary in-car	610 meters	1025 meters	565
Drive	400 meters	750 meters	1197

The following conclusions have been drawn from the trial results:

- The technology tested in this trial failed to meet current FCC accuracy requirements for a network-based location system.
- A national deployment of this technology would require significant resources to deploy.
- This technology is still very immature and requires significant upgrades to be considered commercially viable.